

sufficiently developed to grasp a certain truth, because truth is objective; but it is not proved to be objective by the fact that it is recognised as true by a 'sufficiently developed' intellect. The objectivity of truth lies in the recognition of facts as true by all who understand them fully, whilst the appeal to a sufficient knowledge assumes their objectivity." How anyone can understand facts fully without sufficient knowledge it will puzzle the plain man to discover. And in another passage he writes: "Far above the vulgar idea that the right is a settled something to which everybody has to adjust his opinions, rises the conviction that it has existence in each individual mind, capable of any expansion, proclaiming its own right to exist, if needs be, venturing to make a stand against the whole world." This sentence seems to the writer of this notice a huge mis-statement, or, if true, true only in the sense in which the same sentence must be understood with the words "the truth" substituted for the words "the right."

But to linger over the more controversial aspects of such a book is always an ungrateful task. With the rest of the work there is little fault to be found. The account of the moral emotions, the treatment of punishment (in which subtle arguments are offered against determent as a sufficient guiding principle), the discussion of the various distinctions suggested by terms like act, agent, motive, intention, the detailed examination of the facts advanced by such authorities as Lord Avebury, Dr. J. G. Frazer, Dr. Steinmetz, are all excellent. On the whole, Dr. Westermarck's view of the condition of savage races is one flattering to humanity—if not to civilisation. He points out how much more brutal punishment has often been among the civilised than among the uncivilised. He believes in the "noble savage," and thinks that many accounts of "savagery" among savage races come from a time when they have been affected by a "higher culture," a culture "which almost universally has proved to exercise a deteriorating influence on the character of the lower races." One would like to see a monograph devoted to this subject, and learn what the best missionaries have to say.

#### JOSEPH PRIESTLEY.

*Joseph Priestley.* By T. E. Thorpe, F.R.S. English Men of Science. Edited by Dr. J. Reynolds Green. Pp. viii + 228. (London: J. M. Dent and Co., 1906.) Price 2s. 6d. net.

IT is a curious and unaccountable fact that whilst for more than fifty years we have been in possession of a biography of Cavendish, whose solitary and uneventful existence was chiefly passed within the four walls of his laboratory, a whole century has elapsed without the appearance of any worthy record of Priestley's life, which was so full of human interest and dramatic incident. Following closely upon the centenary commemoration of Priestley's death, the new volume in the series of English Men of Science comes as a fitting and welcome memorial.

That the task should have fallen to Dr. Thorpe

seems perfectly natural and appropriate, and one might feel assured beforehand that the writer of the charming little biography of Humphry Davy, poet and philosopher, would be equally happy in his treatment of the present subject. These anticipations have not been disappointed. The book is not for chemists only. It will attract a wider circle of readers, and will not fail to add to the literary reputation of its distinguished author.

No one has perhaps portrayed his own character in his writings more graphically than Priestley. We know the main events of his life from his own pen; we can study his opinions, religious, political and social, in his numerous brochures; the records of his chemical experiments vividly reflect his scientific habit of thought. All his writings express the same candour and simplicity, the same virile honesty, which were the keynotes of his character.

Priestley has happily been allowed to tell his story as far as possible in his own words, and the abstracts from his memoirs, supplemented by others, notably Miss Aikin's account of the life at the Warrington Academy and Miss Russell's thrilling description of the Birmingham riots, are skilfully woven into a continuous and delightful narrative.

Chemists will naturally turn with special interest to the account of Priestley's scientific labours, and here it must be confessed that the small space, unavoidably, no doubt, allotted to this section is the least satisfying part of the volume.

The vast accumulation of experiments from their discursive treatment and confused arrangement would have repaid careful editing. But if we have not everything, we have at least a substantial record of what is most valuable among Priestley's discoveries.

Priestley was in a sense a follower of Hales. The musket-barrel, the trough for collecting gases, the burning-glass for heating substances in vessels standing over water, are described in the "Vegetable Staticks." Hales, moreover, obtained oxygen, like Priestley, by heating red lead in a gun-barrel, but he never knew that the gas he so carefully collected and measured differed from ordinary air. But if Priestley's experiments were suggested by those of Hales they served only as a foundation to build upon. The improvement introduced by Priestley into pneumatic apparatus would alone have earned for him a lasting reputation and the gratitude of subsequent generations of chemists; but his great discovery was, of course, the recognition of different kinds of air.

As a theorist Priestley's claims are insignificant, for he was particularly unfortunate in interpreting his own observations. Dr. Thorpe says very truly:

"The contrast between Priestley the social, political and theological reformer, always in advance of his times, receptive, fearless and insistent, and Priestley the man of science—timorous and halting when he might well be bold, conservative and orthodox when almost every other active worker was heterodox and progressive—is most striking."

Equally striking is the absence of any well-considered plan in his method of experimenting when his

work is contrasted with that of his three great contemporaries, Cavendish, Scheele and Lavoisier.

One explanation of these defects may be found in the fact that he was not, as he said, "a practical chemist," or, as we should say, a trained chemist. This was perfectly true. That he knew little about the substances which he employed in his experiments is evident from his habit of applying to his chemical friends for such materials as a man like Scheele would never have hesitated to prepare himself, and, moreover, the absorbing interest of his laboratory seems to have obliterated any inclination towards the study of text-books.

Priestley, in both his social and scientific life, seems to have been pursued by an ironical fate. On the one hand his honest zeal in the cause of reform was turned against him to his undoing; on the other, his experiments which were founded on his cherished theory of phlogiston became the weapon which demolished it. Priestley was fortunately endowed with a serene disposition, and in spite of his many misfortunes it would be incorrect to suppose that his life was not a source of real happiness and satisfaction. Such at least may be gathered from the perusal of the volume before us.

J. B. C.

#### SPHERICAL ASTRONOMY.

*A Compendium of Spherical Astronomy with its Applications to the Determination and Reduction of Positions of the Fixed Stars.* By Prof. Simon Newcomb. Pp. xviii+444. (London: Macmillan and Co., Ltd., 1906.) Price 12s. 6d. net.

AS Prof. Newcomb has been in close touch with all branches of the astronomy of position during the last forty years, and as so much of the progress that has been made is his work, a text-book by him on spherical astronomy will be eagerly examined by all who are interested in the subject.

With such qualifications we may be sure, before opening his book, that we shall be conducted to the various points on the frontiers of the subject, some of which it is necessary to occupy before an advance can be made in any direction; and we are also certain to be spared those tiresome digressions into problems such as "To find the season of the year, when twilight is shortest in a given latitude," which serve to degrade astronomy into a mere examination subject.

Let us examine Prof. Newcomb's arrangements. His first three chapters, forming part i., are introductory. They serve to equip the reader with a competent knowledge of spherical trigonometry, interpolation, and least squares. A pleasing feature at the end of each chapter is a page or two of bibliography.

Part ii. opens with a chapter on spherical coordinates. Practical illustration is given of the problem, so simple in theory and so laborious in practice, of turning latitude and longitude into right ascension and declination; and here we find a striking feature differentiating Prof. Newcomb's book from one that would be written by a mere lecturer on

astronomy. The lecturer, if he gave an example at all, would probably work to the nearest tenth of a degree with four-figure logarithms, and tell the reader that that sufficiently illustrates the method. Prof. Newcomb's book is for those who may want to carry out actually calculations of the kind. He therefore places before the reader two different computations of the same problem each with seven-figure logarithms, and knowing that the difficulty is the practical one of keeping out numerical blunders, and not in the last degree the theoretical one of understanding the formulæ, he adds a test computation, thus forcibly insisting upon the superior value of checks by test equations over checks by duplicate computation.

The fifth chapter of the book, the second of part ii., is on time, solar and sidereal, mean and apparent, Greenwich and local, the Besselian and Julian year, with numerical examples.

The sixth chapter is on parallax, naturally subdivided into figure of the earth, and formulæ for parallax in right ascension and so on.

The seventh chapter is a very short one on aberration.

The next chapter is on refraction. "There is perhaps," says the author, "no branch of practical astronomy on which so much has been written . . . and which is still in so unsatisfactory a state." Prof. Newcomb gives an excellent account of the various hypotheses as to the state of the upper regions of the atmosphere. We have not found any allusion to the way in which observed refractions are mixed up with division error, and R-D discordance. The question of systematic corrections has been reserved for a later chapter.

The ninth chapter, the last of part ii., is devoted to precession and nutation. This chapter, in particular, is full of formulæ and data for practical use, and, like the previous chapter, it concludes with an excellent bibliography.

Part iii. is devoted to the "reduction and determination of positions of the fixed stars." It is the part of the book where the author at length closes with the observations, and to which the previous parts are in fact merely introductory. But even now two more chapters of an introductory kind still remain, chapter x., on the application of precession and proper motion, chapter xi., on star corrections. In chapter xii. we come to a description of the methods of observation and allusion to the systematic errors to which observation is liable.

Chapter xiii. may be regarded as the real purpose of the book. It describes how individual catalogues are corrected so as to reduce them to an adopted system, and thus render them comparable with one another. At the end of the chapter is given a list of star catalogues.

The book concludes with an appendix giving tables and precepts for their use. We are inclined to consider some of these tables a mistake, or, at least, their inclusion in this book a mistake. The fact is that tables in constant use wear out very fast, and we